Nutritional management in children with congenital heart diseases in Assiut University Children Hospital

Lamiaa H. Gomaa, Osama M. Elasheer, Nagwa A. Mohammed

Department of Pediatric, Faculty of Medicine, Assiut University, Assiut, Egypt

Correspondence to Lamiaa H. Gomaa, MSC, Department of Pediatric, Assiut University Children Hospital, Assiut, Egypt
Tel: +20 109 682 4786;
Fax: +20882368371;
e-mail: lamiahaussien@gmail.com

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Background
Infants with congenital heart diseases (CHD) are usually born at full term with normal weight for gestational age. Nutritional issues often occur shortly after birth and growth failure appears in the neonatal period, if hemodynamically significant CHD is present. In some cases, the delay can be relatively mild, where as in other cases, the failure to thrive can lead to permanent physical or developmental impairment.

Aim
To assess the degree of adherence to the locally approved guidelines of nutrition for patients with CHD in Assiut University Children Hospital.

Patients and methods
This work is a cross-sectional, observational, and clinical audit study that included all cases with CHDs admitted at the Cardiology Unit in Assiut University Children Hospital from the start of March 2017 to the end of August 2017.

Results
This study included 70 patients (45 men and 25 women) with CHD diagnosed clinically and by echocardiography. Their ages ranged from 1 month to 8 years. Nutritional history was asked about by resident doctors in 45.7% of cases. Tubal feeding was done in 27.1% of the studied cases. Nasogastric tube was inserted in these cases.

Keywords:
congenital heart diseases, feeding management, nasogastric tube, nutritional history

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Introduction

Congenital heart disease (CHD) includes a heterogeneous group of malformations, both in terms of clinical significance of the lesion and pathogenesis.

Its definition is abnormalities in the structure of the heart and great vessels that present at birth, that have or will have a functional response at some point in life. CHDs are among the most frequent anomalies present at birth, with a reported incidence of 8/1000 live births, which have a high effect on neonatal morbidity and mortality (33%) [1].

Infants with CHD are usually born at full term with an appropriate weight for the gestational age. Nutritional problems usually emerge shortly after birth and growth failure becomes apparent in the neonatal period, if hemodynamically significant CHD is present. The degree and type of malnutrition may be related to the CHD characteristics, including the presence of congestive heart failure (CHF), pulmonary hypertension, or cyanosis. Infants with cyanosis may have similar alterations in both weight and length, while infants with acyanotic lesion may have more decreases in weight gain velocity as compared with length [2].

In the last 25 years, descriptions of growth status in acyanotic and cyanotic lesions have modified, as surgical intervention can be done earlier in infancy for children with cyanotic lesions. So, recent studies have indicated that there is more pronounced growth failure and wasting in acyanotic infants [3].

Feeding, the most complex task the infant must perform, needs coordination of motor and sensory pathways of the oropharynx. Abnormalities in swallowing in these infants include inability of sucking, an uncoordinated suck, swallow and breathing and oral transit time. Poor skills in feeding and any dysfunctional swallowing have a direct effect on the ability to feed, and hence the infant's achievement of a normal nutritional state and growth [4].

The etiology of malnutrition in the patient diagnosed with CHD was classified into the following three categories: inadequate intake, inefficient absorption and utilization, and/or increased energy needs [2].

Inadequate energy intake

Decreased caloric intake is the most important cause of malnutrition and growth failure in pediatric patients with CHD. Caloric intake in patients with CHD was 76% that of normal age-matched controls. Fatigue during feeding is a possible cause which explains the decreased intake. Chronic hypoxia causes both tachypnea and dyspnea during feeding, which causes the child to tire out quickly and decreases the amount of food consumed [2].

Decreased absorption and utilization

Intestinal dysfunction caused by a decrease in blood flow to and from the splanchnic circulation often presents in patients with CHD, which leads to malabsorption. This suggests that even children with CHD whose caloric intake is appropriate for their age may not receive enough calories for the achievement of normal weight [5].

Increased energy expenditure

The risks of malnutrition and increased energy requirements depend on the severity and anatomy of the cardiac defect. These risks are related to the presence of CHF), cyanosis, and concurrent pulmonary hypertension. CHF and cyanosis have a negative effect on both weight gain and linear growth [6]. Malnutrition in infants and children with CHD should be prevented rather than expected. Improvement of nutritional status allows infants and children with CHD to achieve growth and development potentials and optimizes surgical outcomes [7]. The early months of life present a time when energy requirements are used to accrete new tissue. Energy costs for growth are about 35% of daily energy requirements in the first 3 months, fall dramatically to 3% at 12 months of age, and become negligible in late adolescence. So early infancy is a critical time, when decreased energy and nutrient delivery can profoundly impair growth [8].

Aim

To assess the degree of adherence to the locally approved guidelines of nutrition for patients with CHD in Assiut University Children Hospital.

Patients and methods

This study was conducted in Assiut University Children Hospital at the Cardiology Unit during the period between the start of March 2017 and the end of August 2017. Approval of the study protocol by Ethical Scientific Committee of Assiut University was obtained They were 70 patients (45 men and 25 women) with CHD diagnosed clinically and by echocardiography. Their ages ranged from 1 month to 8 years.

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Inclusion criteria

All children with CHD who attended and were admitted to the Cardiology Unit and cardiology clinic.

Exclusion criteria

Those excluded were:

(1) Patients with cardiac disease other than CHDs.
(2) Patients with associated chronic illness (TORCH, infection, and inborn errors of metabolism) or with multisystem affection.

The following approaches were applied to all included in this study: present history, neonatal history, and detailed nutritional history.

Examination of children included nutritional assessment, anthropometric parameters, general examination, vital signs, cardiac examination, chest examination, abdominal examination, and neurological examination.

Laboratory investigations included complete blood count (CBC), serum sodium, serum potassium, and serum albumin.

Management included tubal feeding, TPN supplement, and follow-up after nutritional rehabilitation.

Modification of South Africa 2012 guidelines for nutrition in CHD was used as nutrition guidelines for our patients.

Energy requirements:

120–160 kcal/kg of weight.

Carbohydrates:

35–60% of the total calorie value.

Protein:

Infants: preoperative or postshunt 9–11% of total energy up to 4 g/kg actual body weight (abw).
Children: preoperative up to 2 g/kg abw, unless renal function is impaired.

Fat:

Infants will tolerate a total fat concentration of 5–6% (e.g. 5–6 g/100 ml of feed).

Children more than 1 year will tolerate a fat concentration of 7%. Concentrations above this may cause nausea/vomiting.

Fiber:

Age in years + 5 g.

Micronutrients

Sodium:

2–3 mEq/kg/day or 46–69 mg/kg/day.

Potassium:

2–3 mEq/kg/day or 78–117 mg/kg/day.

Calcium:

210 mg/day for children between 0 and 6 months.
270 mg/day for children between 7 and 12 months.
500 mg/day for children aged between 1 and 3 years.

Iron:

2 mg/kg/day for prophylaxis.
6 mg/kg/day if Fe deficient.

Vitamin A:

375–400 μg/day.

Vitamin C:

30 mg/day for infants aged between 0 and 6 months.
35 mg/day for children aged between 7 and 12 months.
40 mg/day for children aged between 1 and 3 years.

Elemental Zn:

1–3 mg/kg abw.

Selenium:

2 mg/kg abw with a maximum of 30 mg/day.
The multivitamins should contain folate, niacin, thiamine and B_{12} and vitamin E.
Do not supplement zinc for longer than 2 weeks.
Selenium and zinc should only be supplemented if failing to thrive and low serum level.
Do not supplement iron during the first10 days postoperatively as it increases the risk of redox.

Entry and exit criteria for nutrition support.

Entry criteria and nutrition support:

Supplementation must be continued for only 6 months if entered onto the nutrition supplementation program.
Children more than 5 years to less than 18 years: when child's growth curve flattened or drops over 2 consecutive months.
Growth failure: downward crossing two or more centiles over a period of 1 month or two consecutive visits.
Middle upper arm circumference (MUAC) less than 12.5 cm in children less than 5 years of age.
Acute malnutrition: weight/height less than 80%, chronic malnutrition: height for age less than 89%.

Exit criteria for nutrition support:

Birth. 5 years: gained sufficient weight to attain a growth curve in relation to his/her normal growth curve and maintains the curve for 3 consecutive months.
>5 years–18 years who attain normal growth curve according to the growth chart within a 6-month period on the nutrition support scheme.
Upward crossing of two or more centiles over a period of 1 month or two consecutive visits.
MAUC more than 13.5 cm in children less than 5 years of age, weight for height (WH) more than 90%, height for age (HA) more than 95% [9].

Results

The data of the studied patients is recorded in Tables 1–6.

Discussion

This is a clinical audit study that included 70 cases with CHD admitted at the Cardiology Unit in Assiut University Children Hospital in a period from the start of March 2017 to the end of August 2017. The aim of this study is to assess the degree of adherence to the nutritional guidelines of CHD patients.

Corresponding to the guidelines in this study, the feeding history was recorded in 45.7% of cases.

In the present study, data about the age of onset of feeding difficulties was recorded in 32.9% of cases.

History of environmental distraction was recorded in 4.3% of cases.

Table 1 Recorded data about nutritional history

	n (%) (*n*=70)
Feeding history	
Not recorded	32 (45.7)
Recorded	38 (54.3)
Type of feeding	
Recorded	32 (45.7)
Not recorded	38 (54.3)
Frequency of feeding	
Recorded	28 (40)
Not recorded	42 (60)
Duration of feeding (20 min)	
Recorded	20 (28.6)
Not recorded	50 (71.4)
Age of onset of feeding difficulties	
Recorded	23 (32.9)
Not recorded	47 (67.1)
History of feeding difficulties or GIT problems	
Recorded	49 (70)
Not recorded	21 (30)
Environmental distractions (such as watching television, talking on the mobile)	
Recorded	3 (4.3)
Not recorded	67 (95.7)
Signs of feeding difficulties	
Recorded	27 (38.6)
Not recorded	43 (61.4)

GIT, gastrointestinal tract.

Table 2 Recorded data about nutritional status

	n (%) (*n*=70)
Weight	
Recorded	70 (100)
Not recorded	0
Height	
Recorded	70 (100)
Not recorded	0
Head circumference	
Recorded	70 (100)
Not recorded	0
Mid-upper arm circumference	
Recorded	32 (45.7)
Not recorded	38 (54.3)
Triceps skin-fold thickness	
Recorded	0
Not recorded	70 (100)
BMI	
Recorded	10 (14.3)
Not recorded	60 (85.7)

Data of history of signs of feeding difficulties was recorded in 38.6% of cases.

Growth is the best indicator of health in infants and children. So the nutritional status of all infants and children with CHD must be assessed initially and at regular intervals thereafter; the frequency of follow-up assessments should be determined on the basis of age, clinical status, and nutritional risk. The key areas are the evaluation of growth, intake, and nutrient

Table 3 Recorded data about the signs of malnutrition

Signs of malnutrition [*n* (%)]	
Recorded	70 (100)
Not recorded	0
Micronutrient deficiencies [*n* (%)]	
Recorded	70 (100)
Not recorded	0

Table 4 Recorded data about laboratory investigations done in the studied patients

	n (%) (*n*=70)
CBC	
Done	70 (100)
Not done	0
Serum Na, K	
Done	70 (100)
Not done	0
Serum albumin	
Done	30 (42.9)
Not done	40 (57.1)

CBC, complete blood count; K, potassium; Na, sodium.

utilization [10]. In this study, the anthropometric measures (weight, height, head circumference) were recorded in 100% of cases that correspond to the guidelines.

Mid-upper arm circumference was done in 45.7% of cases. Triceps skin-fold thickness was not recorded in any case. Triceps skin-fold thickness and mid-arm circumference have been used to estimate fat stores and lean body muscle mass, respectively, but these measurements are affected by edema [11].

According to laboratory investigations CBC was done in 100% of cases. This is corresponding to the guidelines, as most cases of CHD may have low Hb, microcytic anemia, and macrocytic anemia [9].

In this study, serum sodium and serum potassium levels were measured in 100% of cases. Hyponatremia, hypochloremia, and contraction alkalosis are common electrolyte and metabolic disturbances in the cardiac ICU [12].

Serum albumin was done in 42.9% of cases. Biochemical markers and their use as surrogate markers of nutritional status have been studied including serum albumin, prealbumin, transferrin, transthyretin, retinol-binding protein, and C-reactive protein. In the population with CHD, albumin is the most widely studied biomarker [11].

In this study, tubal feeding management was done in 27.1% of cases.

Nasogastric tubes may be beneficial by providing a route to optimize nutrition and avoid the risks of

Table 5 Feeding management of the studied patients

	n (%) (*n*=70)
Tubal feeding	
Done	19 (27.1)
Not done	51 (72.9)
Total parenteral nutrition supplement	0

Table 6 Follow-up after nutritional rehabilitation of the studied patients

	n (%)
Follow-up after nutritional rehabilitation (*n*=70)	
Done	48 (68.6)
Not done	22 (31.4)
Optimum energy, protein, and micronutrients intake according to ideal needs	
Done	35 (72.9)
Not done	13 (27.1)
Monitor weight at 2--week intervals (*n*=48)	
Done	48 (100)

surgery. However, several potential complications of nasogastric tubes may result in relatively short-term utility [13].

In this study, follow up of the cases was done in 68.6% of them as all patients with CHD are chronic patients and they are regular in their visits for follow-up.

In this study after the follow up, optimum energy, protein, and micronutrient intakes according to the ideal need was done in 72.9% of cases.

Conclusion

In general, children with CHD are at high risk of malnutrition, and further nutritional depletion during frequent hospital admissions deteriorates the condition. Poor anthropometry is associated with increased morbidity and mortality.

Energy intake and utilization are key factors affecting nutritional status and subsequently can affect developmental and surgical outcomes, morbidity, and mortality. The intimate adherence with the guidelines of nutrition for patients with CHD is very promising.

In this study, good adherence with the guidelines was related to history, weight, height, head circumference, CBC, serum sodium, and serum potassium.

On the other hand, there was some poor adherence with the guidelines related to nutritional history, mid-upper arm circumference, triceps skin-fold thickness, serum albumin, tubal management, and follow-up.

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Conflicts of interest

There are no conflicts of interest.

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